Stephen Mueller (TVA)
on behalf of the
Electric Power Research Institute

Fugitive Coal Dust Emission Factors: Dependence on Moisture

Motivation for Work

Fugitive dust from work on coal piles is often the primary uncontrolled source of particulate emissions at a coal-fired power plant

- Issue: *AP-42* particle emissions factor (EF) formulation applicable to equipment driving on coal piles does not consider coal moisture. Fugitive emissions at locations experiencing precipitation can vary considerably with moisture.

- Study: Data collected at active coal pile were used to determine EF sensitivity to coal moisture. AERMOD used to link obs. concentrations and emissions. Resulting EF formulation can be used to calculate estimates of daily and annual particulate emissions from PRB coal piles.

Fugitive Dust Emission Factors (EFs) Applied to Bulldozers on Coal Piles

- AP-42 EF for vehicles on unpaved industrial surfaces:

  $$EF_{AP42} = a(S/12)^{b}\,(W/3)^{c}$$

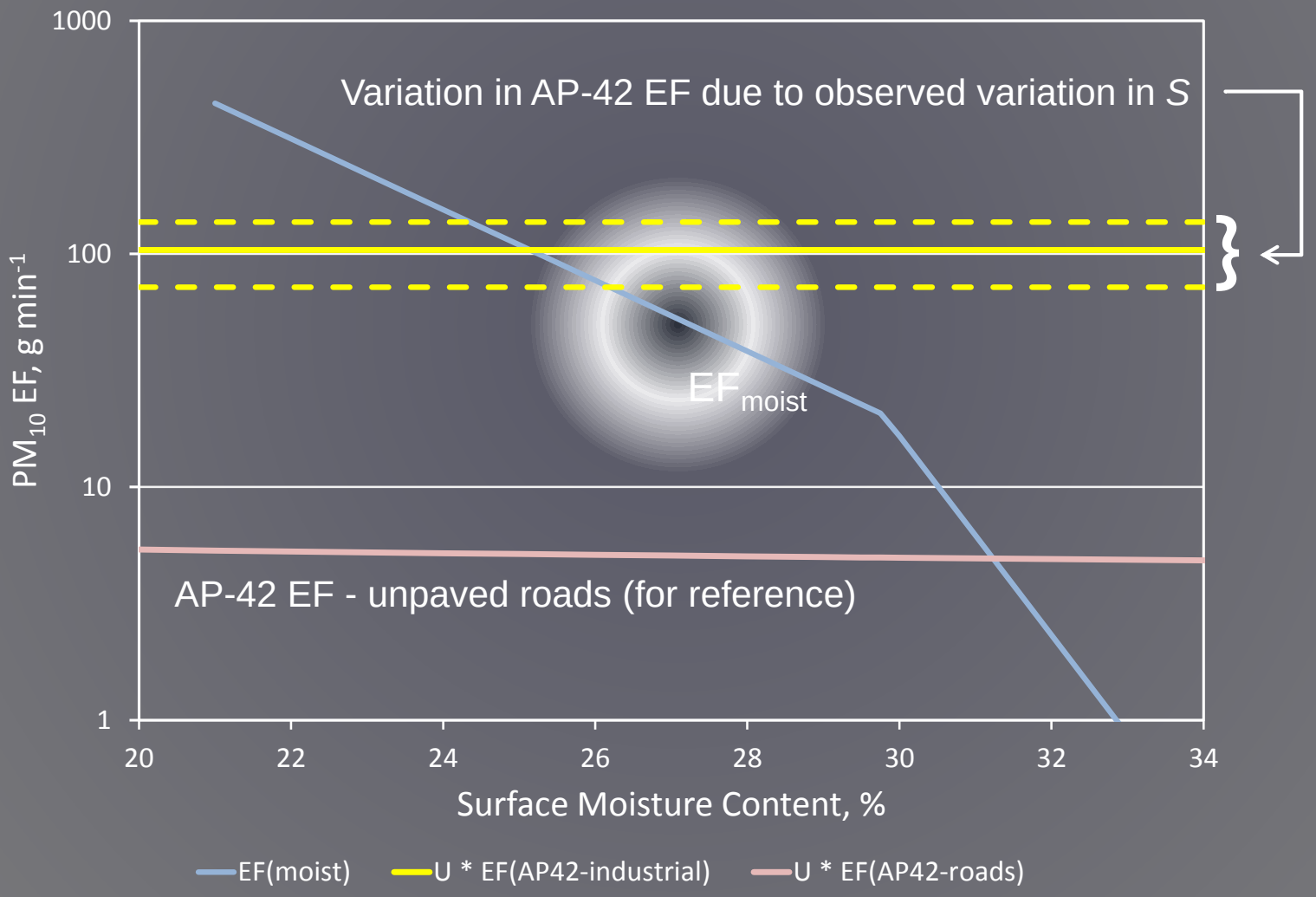
  where S is silt content, W is vehicle weight (a, b & c are particle-size dependent constants).

- EPRI study of coal pile (S & W invariant):

  $$EF_{moist} = \alpha 10^{\beta M_c}$$

  with M_c is coal moisture content (coefficients α and β depend on range in M_c ; β <0).

Emission Factors Compared



Determining M_c

- Observed soil moisture (M_s) was a surrogate for M_c:

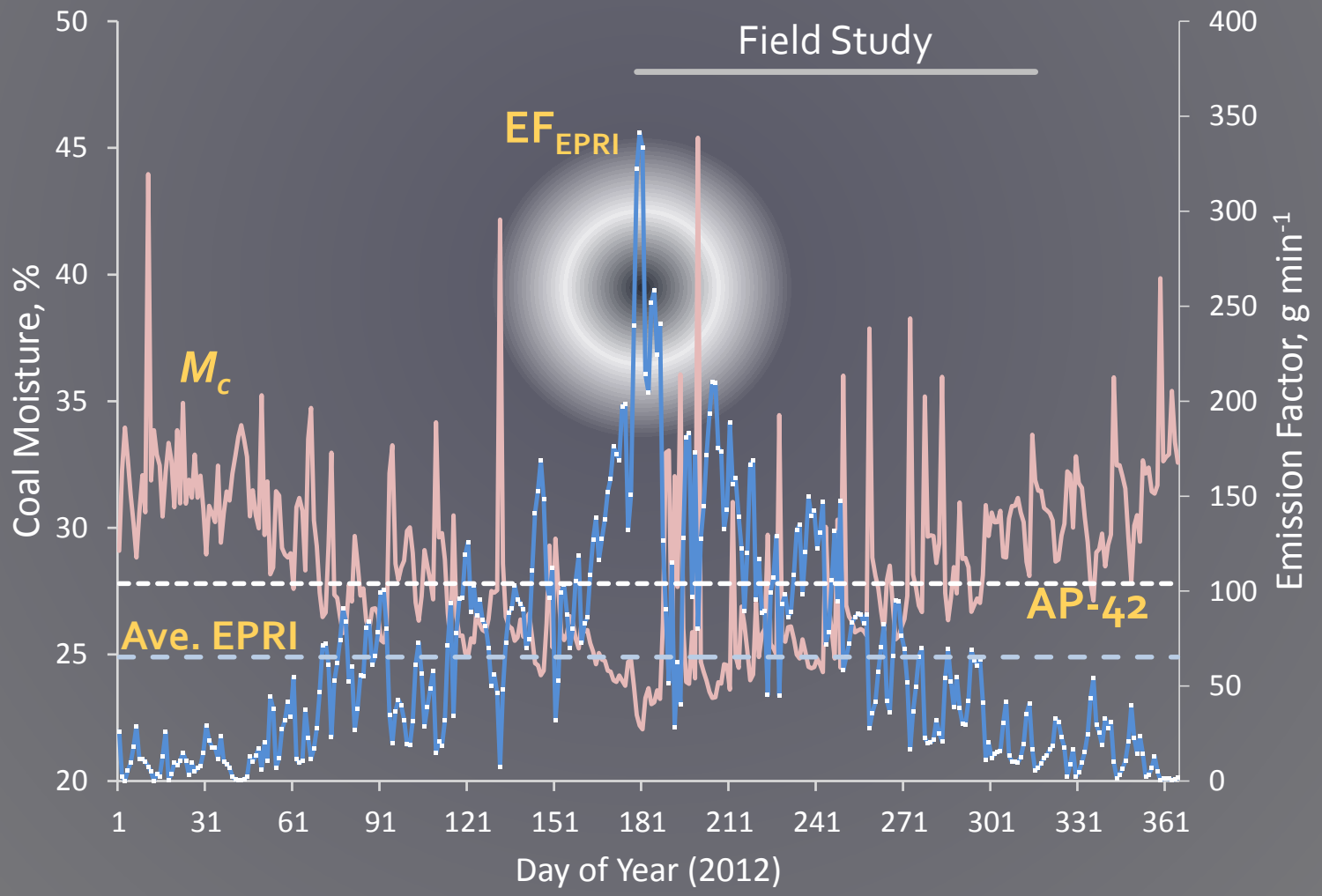
  $M_c = 0.38M_s + 19.69$ (r^2=0.85).

- From on-site daily-averaged data,

  $$\overline{M_c} = 33 - 0.318\,\bar{T}_2 + 10.4\,\bar{P}_6$$

  where T_2 and P_6 (with overbars) represent daily averaged air temperature (°C) and 6-hr cumulative precipitation amount (cm).

M_c Methodology Applied to Nashville



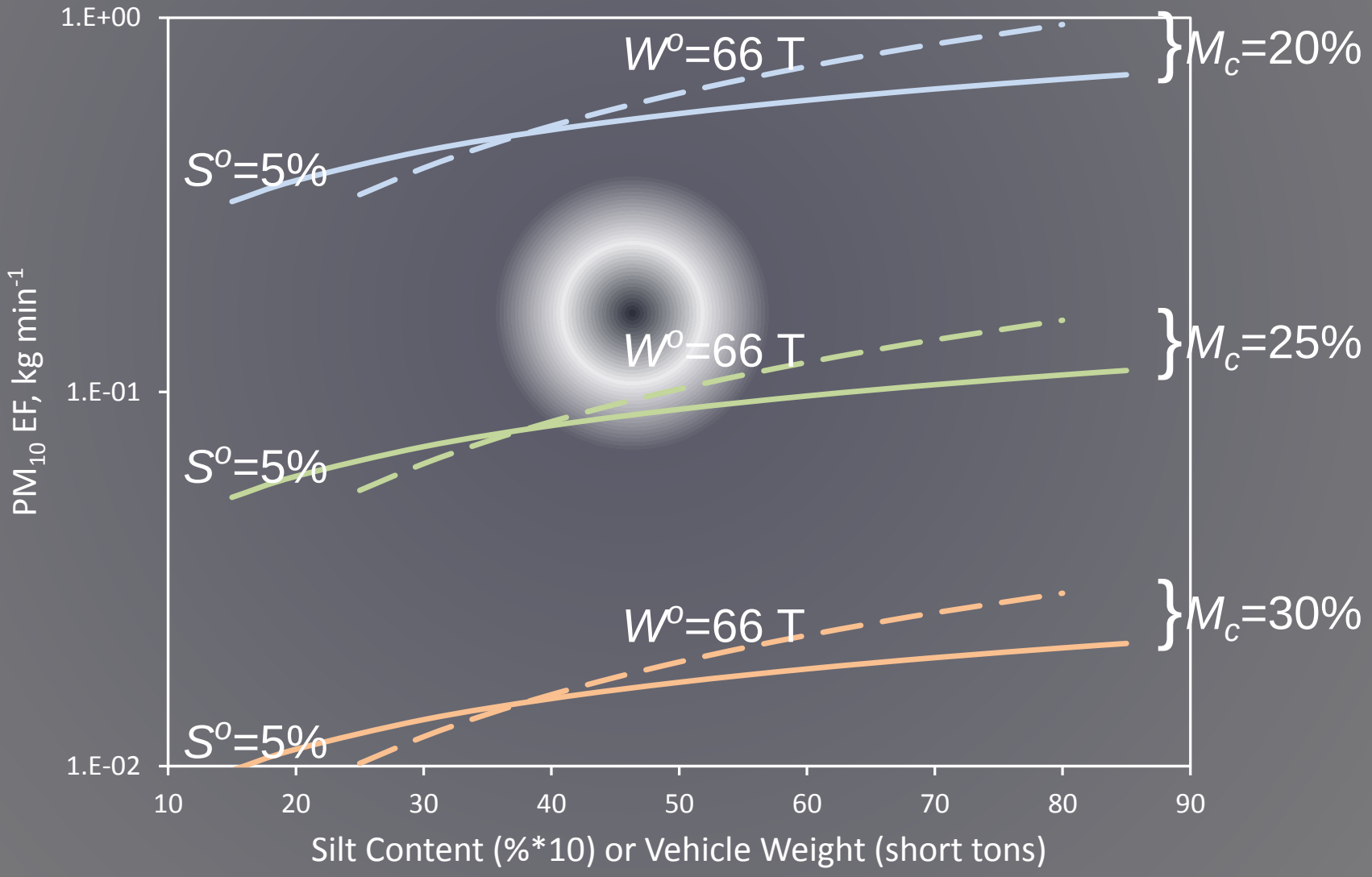
How to reconcile EF_{AP42} and EF_{moist}?

- Assume $\frac{\Delta EF_{AP42}}{EF_{AP42}} = \frac{\Delta EF_{moist}}{EF_{moist}}$ (i.e., have same sensitivities to S, W & M_c).
- Then, for conditions S' and W' we derive EF' from reference conditions S^o and W^o as

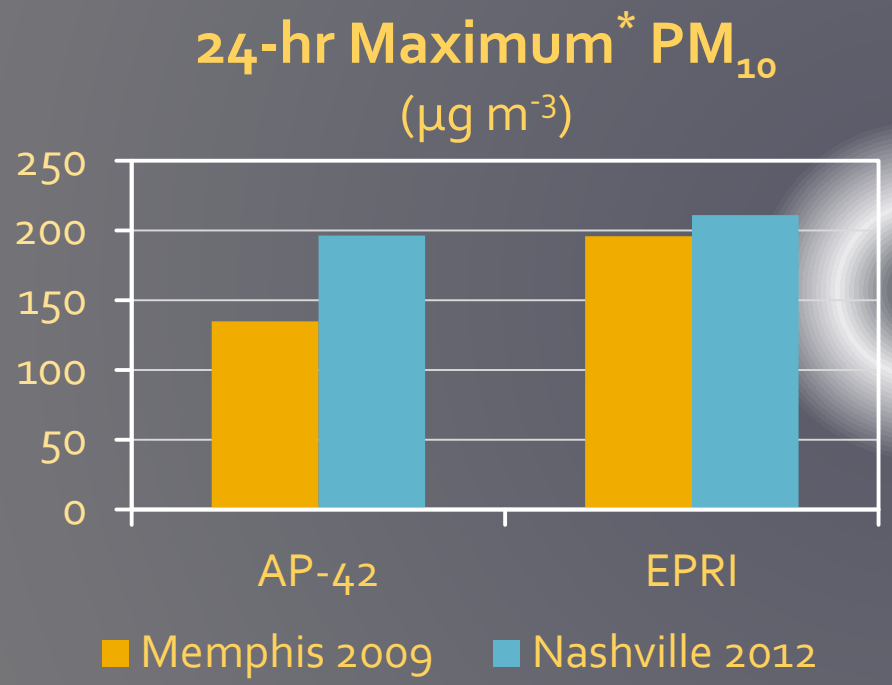
$$EF'_{moist} = EF^o{}_{moist}\left[1 + \frac{EF_{AP42}(S', W') - EF_{AP42}(S^o, W^o)}{EF_{AP42}(S^o, W^o)}\right]$$

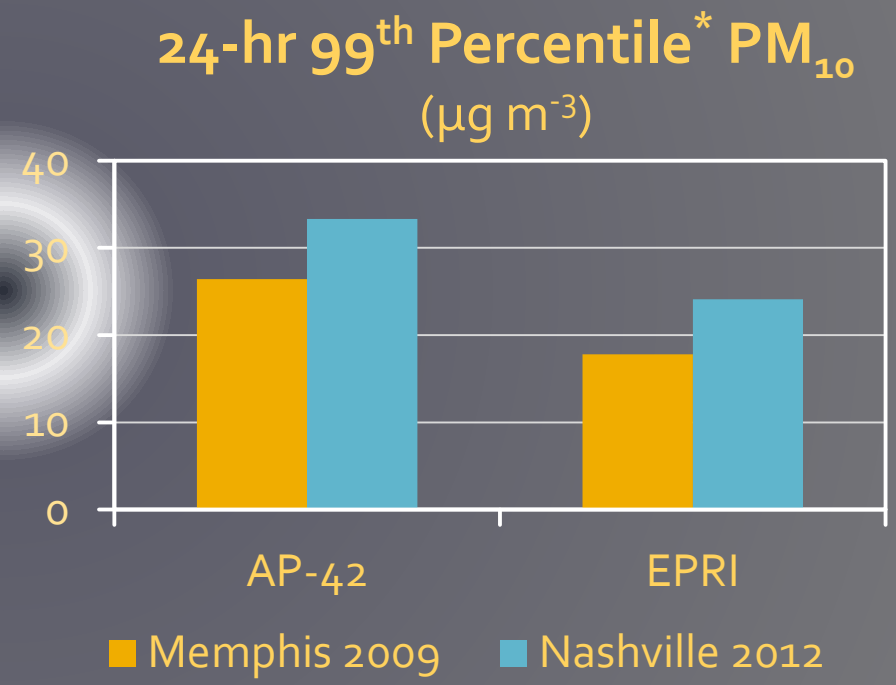
where S' and W' are any valid conditions for which EF_{AP42} is applicable, S^o =5% and W^o =66 short tons.

Comparison of EF Sensitivity



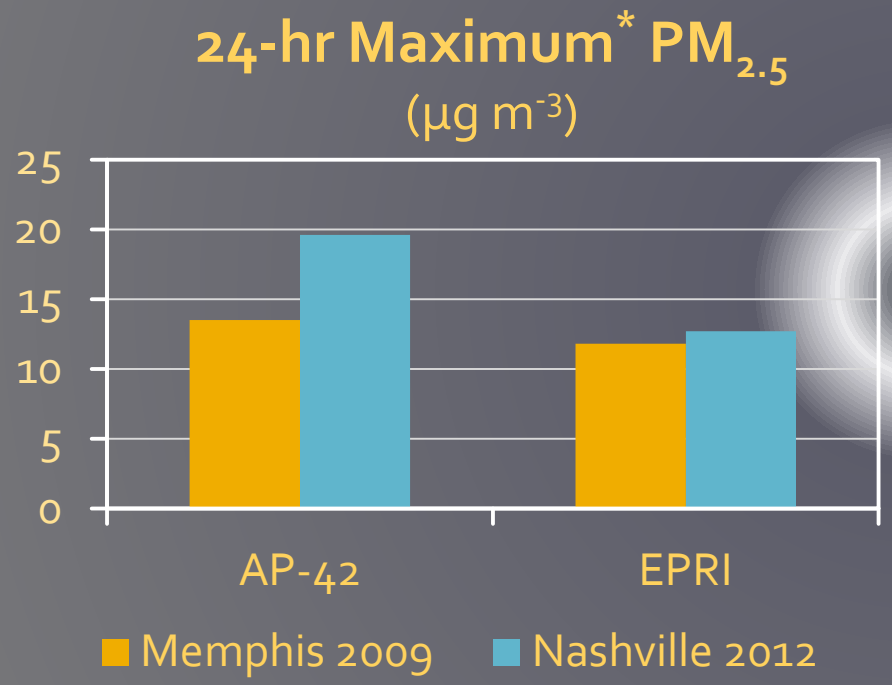
Simulated 24 hr PM_{10} Levels from Hypothetical 3.8 ha Coal Pile

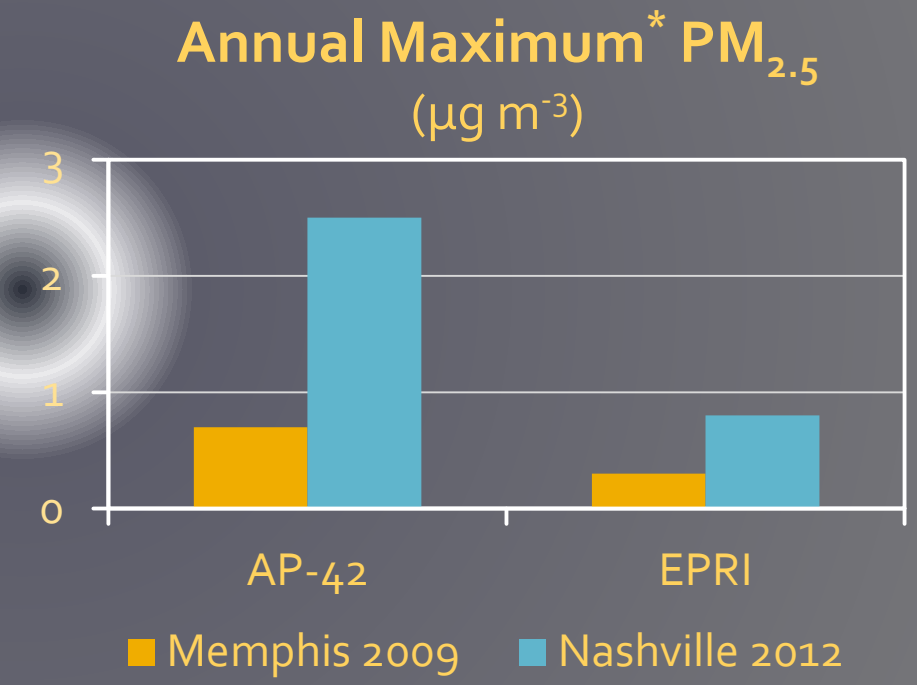




*As computed by AERMOD beyond an assumed 1000 m site boundary for a source operating 24 hr/day.

Simulated Daily & Annual $PM_{2.5}$ from Hypothetical 3.8 ha Coal Pile





*As computed by AERMOD beyond an assumed 1000 m site boundary for a source operating 24 hr/day.

AP-42: $PM_{2.5}/PM_{10} = 0.10$ EPRI: $PM_{2.5}/PM_{10} = 0.06$

Conclusions

- Measurements indicate that fugitive coal dust emissions are more sensitive to coal moisture than either silt content or vehicle weight.
- A method that combines emission sensitivities represented by the EPRI study and AP-42 formulations enables EF estimates that adjust to moisture, silt content and vehicle weight.
- Applying a method that uses meteorological data to estimate coal moisture allows calculation of daily dust EFs that yield higher extreme emissions during very dry conditions while also accounting for the mitigating influence of moisture during much of the year.